Quantification of denudation in the Iberian basins, erosional signal of continental scale capture processes

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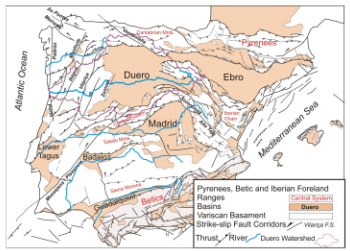


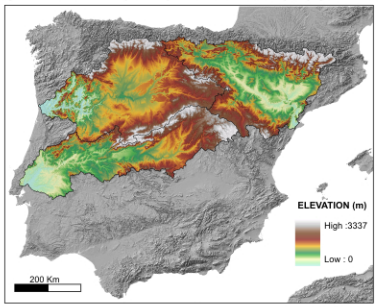
2 The present-day topography of Iberia is the result of a complex moving of the Iberian microplate that started in early Cretaceous times with the northward propagation of the Atlantic Ocean, and the collision of the northward moving African plate with Europea plate.

1 In central and northern Iberia, the development of the present-day drainage network was related to the opening of formerly closed fluvial systems developed within the ancient Cenozoic basins. The lowering of base level, induced by tectonic activity, fluvial capture or eustatic or climate variability, was transmitted upstream along fluvial channels in the form of erosional waves. For the main foreland basins in Iberia (Duero, Tajo and Ebro Basins) the opening of an outward drainage system leads to high incision and denudation rates, within intrabasinal areas. These processes had main influence in the evolution of the Iberian topography, since the late Cenozoic. Although, key questions on the timing and processes involved in the basin opening, as well as the influence of tectonics on it, remain open.

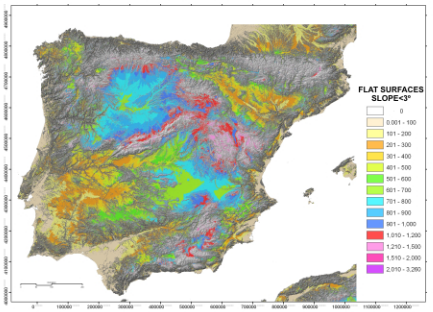
Signals of this change in drainage conditions are still preserved in some areas, and can be analyzed by the study of longitudinal profile shapes, and by the analysis of the present topography and the spatial distribution of surface erosion associated to the exorheic history of the basins.

The analysis of the denudation processes for these main basins, through the reconstruction of the former (Late Miocene) sedimentary infill, provides a quantification of the sediment fluxes in response to the drainage opening. Maps of denudation are performed for the different basins, allowing the integrated analysis of erosional volumes and spatial distribution of dissection in terms of timing, tectonic influences and the fluvial response to the captures.

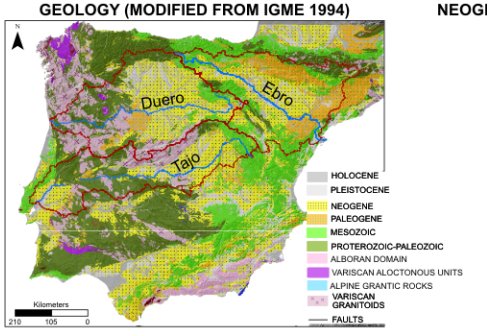
DIGITAL ELEVATION MODEL-IBERIA TOPOGRAPHY



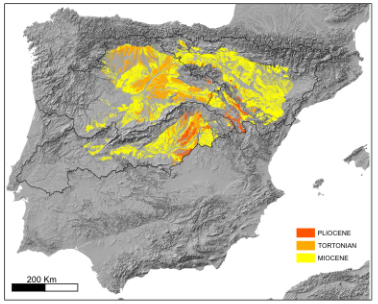
FLAT TOPOGRAPHY ELEVATION



GEOLOGY (MODIFIED FROM IGME 1994)



NEOGENE DEPOSITS PRESERVED IN THE MAIN BASINS



3 The Iberian topography is characterized by a high average elevation and by the presence of highly elevated flat surfaces developed all over Iberia (Iberian Mesetas).

High plains in Iberia correspond to planation surfaces developed mainly on Palaeozoic and Mesozoic rocks, and sedimentation surfaces of Neogene rocks. These last mostly represent the sedimentary deposits related to infill of the, formerly closed, main Cenozoic Iberian Basin (Duero, Tajo, Ebro).

4 The basin configuration in Iberia is peculiar because mayor sedimentary basins were endorheic systems during most of their depositional history, trapped within the Alpine ranges and the uplifted variscan basement. Afterward those internal drainages were captured by Mediterranean (Ebro) and the Atlantic (Duero and Tajo) fluvial networks.

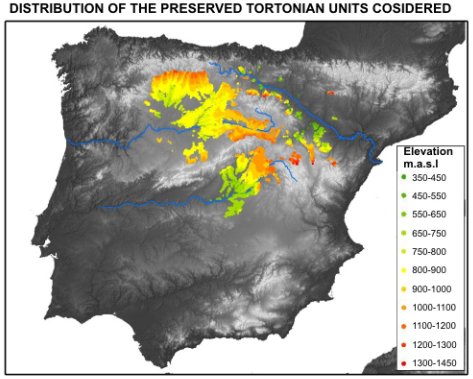
Once the internal basins were captured by the external drainage systems the fluvial network is a mayor responsible for the landscape denudation, erosion and sediment transport, at the continental scale.

5 FORMER DEPOSITIONAL SURFACES RECONSTRUCTION

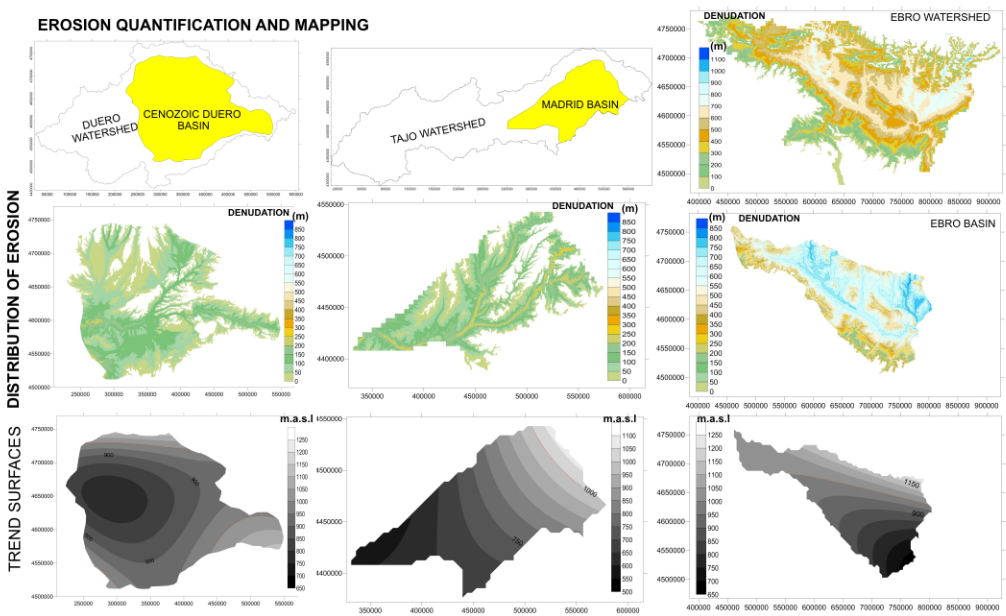
By means of geological mapping, geostatistical tools, GIS and DEM we performed the reconstruction of the former late Miocene paleorelief in the Cenozoic basins. The method consists in the recovery of the paleosurface (topography) characteristic of the last stages of the closed Iberian basins infill. For this we use geological data from the Spanish Geological Survey (IGME), selecting the preserved represetative formations for the pourpose (Tortonian sedimentary units). With the selected units we performe polynomial regression trend surfaces.

Polynomial Regression is used to define large-scale trends and patterns in a set of data. It is not really an interpolator because it does not attempt to predict unknown Z values. There are several options you can use to define the type of trend surface, and although different calculation were performed for each basin, in this work we present the options which better fit the data and basin morphology (second order polynomial regression for the Tajo and Ebro, and cubic surface for the Duero).

DISTRIBUTION OF THE PRESERVED TORTONIAN UNITS COSIDERED



EROSION QUANTIFICATION AND MAPPING



ERODED MATERIAL VOLUMES AND MEAN SURFACE LOWERING

	Positive Area [Cut] km^2	Negative Area [Fill] Km^2	Total area	**Removed Volume [Cut] Km^3**	Mean surface lowering* (m)	**Mean surface lowering** (m)**
EBRO WATERSHED	64853	15319	80172	**28313**	353	**437**
EBRO BASIN	34270	1643	35913	**16613**	463	**485**
TAJO-MADRID BASIN	12349	5105	17454	**1227**	70	**99**
DUERO BASIN	33527	10659	44186	**2407**	54	**72**

6 DISCUSION

Using topographic geostatistical analysis we make a first attempt to reconstruct the surface that represents the top of the endorheic sedimentary sequences in the Iberia basins (Duero, Tajo, Ebro).This allows to quantify the impact of the basins' opening in terms of denudation, sediment fluxes and dissection distribution.

Results represent minimum erosional volumes, as preserved surface may have already experienced erosional proceses. For the Duero Basin results indicate that a minimum volume of 2100+/-400 106 m3 of rock and sediments have been removed since the start of the exorheism. This volume represents a mean denudation (surface lowering) of 60+/-10 m. These values are similar to those obtained for the Madrid Basin. But when compared to the Ebro Basin, eroded volumes became one order of magnitude higher and the surface lowering is almost five fold bigger. These data together with the topography, and the longitudinal profiles' morphology (Anton et al, 2012; Soria and Anton, in prep) seem to point to a significantly younger capture's age for the Tajo and the Duero basins. Although in debate and not accurately dated, estimations for Ebro basin opening point to ages between 8 and 12 My (Garcia-Castellanos et al., 2003) o post Mesinian, ~5 My, (Babault et al., 2006). May the Duero capture be five times younger?

Although tectonic is the main responsible of the built up of Iberian topography, no clear indicators are identify so far about its direct participation in the drainage captures. However erosional pattern may reflect some tectonic influence. In the Ebro Basin the denudation is higher in the northern side and the trunk channel position is quite asymmetrical. Similar situation occurred in the Madrid Basin, while in the Duero higher denudation occurs in the southern side and the sedimentary terraces (not ilustrated here) indicate channel migration northward.